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## REMBRANT: Research on the Effects of Microgravity on the BRAzil NuT problem

Getaway Special Team 2009

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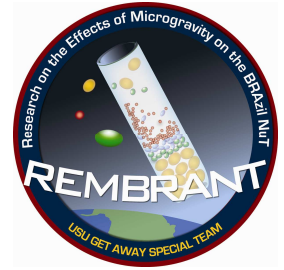
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# REMBRANT



Research on the Effects of Microgravity on the BRAzil NuT problem

## Project Overview

REMBRANT was developed to simulate and study the Brazil Nut problem in microgravity. The Brazil Nut problem studies the granular segregation effect that causes larger particles in a mixture to rise when vibrated on Earth. This phenomenon gets its name from Brazil nuts rising to the top of cans of mixed nuts during transport. The goal of this experiment is to isolate the role of inertia in the segregation of particles by eliminating gravity based forces.

## Payload Requirements

**Mass:** 50 g

**Dimensions:** 19 mm x 19 mm x 95 mm

**Power:** None

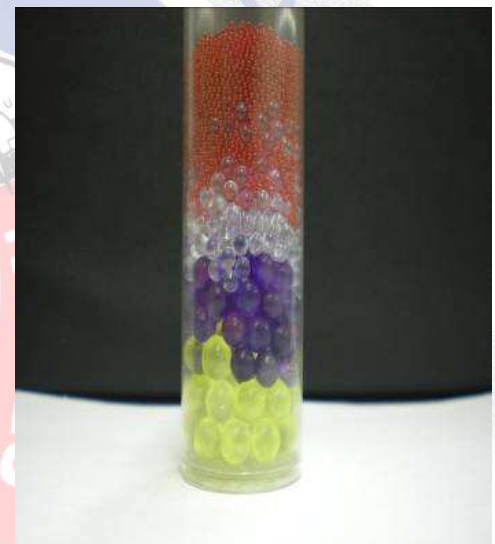
**Data Acquisition:** 10 min

## Experiment Objectives

This experiment will gather unique information on the granular separation process. The data will be helpful in computer modeling of granular systems and on-orbit pharmaceutical processing.

Data to be analyzed includes:

- Granular segregation patterns
- Particle displacement
- Glass bead convection, dynamics, and orientation



REMBRANT prototype

## Scientific Justification

Inertia, convection, buoyancy, and static attraction are all factors of the granular transport segregation problems. Convection and buoyancy effects are eliminated through in this microgravity experiment the use of microgravity conditions. Static attractions will also be minimized. This will allow data results to be solely dependent upon the effects of inertia.

Granular separation is an important process in terrestrial applications, such as the processing and storage of grains, mining, materials processing, and pharmaceuticals. This also has application in space based materials processing, crystal growth, and high purity pharmaceutical development. Understanding granular segregation at a more fundamental level—particularly when the effects of buoyancy and convection are minimized—can lead to improved transport, storage and processing methods. It can also address fundamental science issues such as the Brazil Nut problem.



## Experiment Design

The experiment is sealed in a 19 mm x 19 mm x 95 mm polycarbonate container. This small container will make transportation easy and ensure easy operation. Inside the container is a mixture of 1 mm and 2 mm polystyrene beads coated with an antistatic layer. The mixture consists of a 50/50 volume ratio of the various colored beads. Colored beads enhance contrast and increase visibility of individual beads. A video camera fixed to the container will record the bead motion as the container is slowly shaken. A test protocol of the agitation will be developed, specifying the container orientation and the frequency and intensity of motion. Tests should be carried out more than once by rotating the orientation of the container and then repeating the test. Ground tests will be recorded by GAS students and (if desired) by the SFP prior to launch for direct comparison with microgravity experiments.

## Involvement of the Space Flight Participant (SFP)

SFP training will be minimal. The SFP will need to become familiar with camera operations and practice shaking the container as described in the test protocol, visually recording the results. The SFP may also provide audio commentary describing the experiment as it is performed.

**SFP On-orbit Time Required: 15 min**  
**SFP Training Time Required: 10 min**  
**SFP Ground Test Time (optional) 30 min**

## Critical Safety Issues

The only safety risk identified is rupture of the cell and dispersment of the polystyrene beads. The beads are large enough not to pose a health risk. The cell is made of high impact polystyrene with the ends sealed by fusing the polycarbonate with methylene chloride. A rupture test will be performed by filling the cell to atmospheric pressure and then placing it in a vacuum chamber.

## Project Timeline

The prototype apparatus is in the last stages of development. Final plans for video protocol and data acquisition are currently being established.

The timeline to the right has the estimated times of completion for each milestone. These milestones include safety tests, preliminary testing and launch availability date.

Date	Milestone
May 18	Safety test complete
May 26	Submit prototype for review
June 15	Prototype results
June 22	Ground testing and videos complete
June 29	Apparatus and Instructions delivered to SFP

## Project Lead

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